Astrophysics and Geophysics

MORPHOLOGY CORRELATIONS OF LARGE-SCALE STRUCTURES

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Through comparisons of computer-generated simulations of structure formation to the actual sky, cosmologists are able to gain a refined understanding of Big Bang Theory, clues to the composition of the currently mysterious dark matter, and help in deciphering the intricate astrophysics of galaxy formation. This project, Morphology Correlations of Large-Scale Structures, uses such simulations to investigate the creation of galaxy clusters in the universe. The Hubble Volume Project data used in this research consists of the largest N-body simulations in the world with a billion particles per simulation and involves models that investigate structure formation in both the λCDM and τCDM cosmologies. By providing such massive samples, the data allows for statistically precise studies of the cluster population and enables investigation of very rare events. Through the creation of Interactive Data Language (IDL) programs that calculate moments of inertia for the cluster samples and the ongoing development of more programs, specific questions can be answered about galaxy formation. Some such questions involve correlations between shape and location, shape and density, shape isotropy, or cluster evolution. The first results to be acquired from this project include results showing the velocity field to be somewhat rounder than the density field and a spatial correlation indicating a strong alignment of the density and velocity principle axes. Current research has found that the shapes of clusters and their tendency towards alignment contain clues to the formation of large-scale structures.